Research Paper | Science | E-ISSN No : 2454-9916 | Volume : 3 | Issue : 10 | Oct 2017

Effect of Water Stress and Salt Stress on Anatomy of Bryophyllum pinnatum

Sushmita Negi

Assistant Professor, Department of Botany, S. S. & L. S. Patkar-Varde College, S. V. Road, Goregaon (West), Mumbai-400062, India.

ABSTRACT

Bryophyllum pinnatum (Lam.) Oken, a member of family Crassulaceae, is known to have multiple active compounds such as alkaloids, triterpenes, lipids, flavonoids, glycosides, bufadienolides, phenols and organic acids. Various parts of *Bryophyllum pinnatum* show antimicrobial, antihypertensive, antidiabetic, antihelmentic. Anti-inflammatory, anticancer, antioxidant, antihistaminic and antiallergic properties. It is a succulent that tolerates water stress and high salinity. In this paper the effect of salinity and water stress on internal morphology has been studied. It was found that under extreme conditions of salinity and water stress, the concentration of idioblast, i.e., the cells containing anthocyanin pigment, and starch grains increases in leaf, stem and petiole. Leaf anatomy exhibited that the mesophyll is not differentiated into palisade and spongy parenchyma. Instead, it has simple chlorenchyma.

KEYWORDS: *Bryophyllum pinnatum,* Salinity, Water stress.

INTRODUCTION:

Bryophyllum pinnatum, a member of family Crassulaceae, is commonly known as air plant, love plant, miracle leaf, life plant, Zakham-e-hyat, panfutti, Ghayamari (Jain et al. 2010). Different parts of the plant have been used traditionally against various ailment such as diarrhea and vomiting, earache, burns, abscesses, gastric ulcers, insect bites, smallpox, cough, asthma, palpitations, headache, convulsion and general debility, edema of legs in different parts of the world (Chopra et al., Agoha 1974). Multiple active compounds such as alkaloids, triterpenes, lipids, flavonoids, glycosides, bufadienolides, phenols and organic acids has been reported to be present in various parts Recent research in this direction has proved antimicrobial, anti-ulcer, antihypertensive. antileishmanial, antidiabetic, antihelmentic. anti-inflammatory, anticancer, antioxidant, antihistaminic and antiallergic properties in various parts of *Bryophyllum pinnatum* (Afzal et al.2012). On the other hand easy vegetative propagation, fleshy texture, attractive foliage and flowers make *Bryophyllum pinnatum* an ideal, and desirable ornamental. As a succulent it tolerates water stress and high salinity. It is a known fact that salinity and water stress conditions retard plant growth causing stunted growth, smaller leaves, and altered intermodal length. In this piece of research work an attempt has been made to study the effect of water stress and salinity on the anatomical features of *Bryophyllum pinnatum*.

MATERIALAND METHODS:

Collection of plant material: Plant samples were collected from Aarey Nursery at Goregaon (west), Mumbai and authenticated as *Bryophyllum pinnatum* (Lam.) Oken (family: Crassulaceae) with the help of Herbarium.

Cultivation and water stress and salinity treatment: Young Saplings of *Bryophyllum pinnatum* were cultivated in pots as control and under salt and water stress conditions for a period of four months starting from September 8, 2016 to December 2016.

For salt treatment saplings were irrigated with aquous solutions of 10 and 20 ppm NaCl. For water stress treatment the plants were irrigated at 15 days intervals. In addition to this another set of plants was maintained as control in which normal fresh water (tap water) was used for irrigating the plants.

Anatomical studies: Anatomical studies of petiole, leaf and stem were carried out with the help of hand sections, stained with safranin. For stomatal index, leaf peelings were taken from lower surface of leaf samples. Images were photographed using microscope.

RESULTS:

T.S. of petiole: Petiole outline was circular and epidermis was single layered. Cells were small and cubicle in shape. Outer walls were lined with cuticle. Epidermis is followed by cortex made up of thin walled parenchyma cells. Cortex is differentiated into two regions outer and inner. Outer region shows presence of cells filled with starch grains which is lacking in the inner cortex.

Presence of starch grains is noticed on all samples i.e., treated and control. However starch grains were more abundant in treated plant samples than in control i.e., 20ppm followed by 10ppm followed by normal. Inner cortex shows presence of anthocyanin pigments whose concentration was comparatively high in water stress samples. Single median vascular bundle is bounded with endodermis. Xylem is roughly crescent shaped.

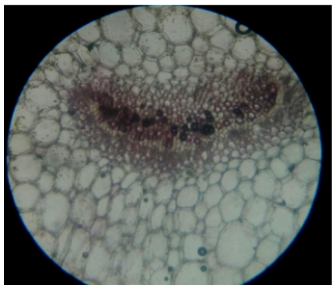

Fig. 1: T.S. Petiole showing crescent shaped vascular bundle.

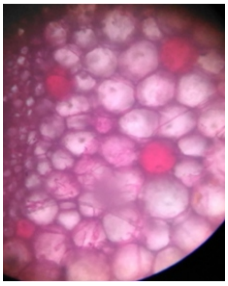

Fig. 2: Anthocyanin pigments in parenchyma

T.S of leaf : Upper epidermis is waxy and cuticle is quiet prominent. Lower epidermis is also cuticularised. Epidermal peeling showed presence of anisocytic stomata on both upper and lower epidermis. They were not sunken. Epidermal cells are small and cubicle. Hypodermis has small sized cells having green pigments. Mesophyll is not differentiated into palisade and spongy parenchyma. Instead, it has simple chlorenchyma cells full of chloroplast pigments. Intercellular spaces are almost lacking (Fig.3, Fig.4) Chlorenchyma of inner region is comparatively larger than hypodermis. In the single median vascular bundle pericycle is seen. It is made up of very small barrel shaped cells. Xylem is seen facing upwards towards upper epidermis. It is somewhat boat shaped; within the cavity of xylem, patch of phloem is present. Median vascular bundle is conjoint and collateral. Smaller vascular bundles are present on lateral sides of the lamina. Anthocyanin pigments are present in the hypodermis and inner region of chlorenchyma. Anthocyanin and green pigments indicating plastids are comparatively high in number among the chlorenchyma of 20ppm leaf sample followed by 10ppm and control. However in water stress leaf sample, their number is more than control but less than 10ppm and 20ppm.

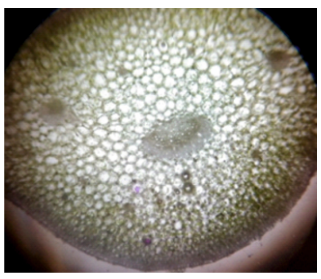

Fig. 3: V.S. Leaf showing median vascular bundle.

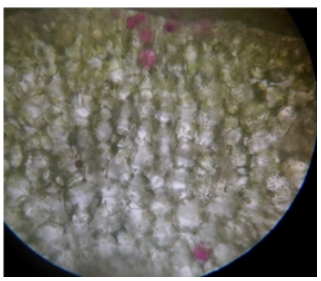

Fig. 4: Anthocyanin pigments in the chlorenchyma

T.S. Stem: Epidermis has a thick waxy cuticle. Periderm differentiation is notable in the outer region of cortex. Outer cortex comprises of small thin walled cells while inner cortex has large sized cells. Both the cortex regions are made up of chlorenchyma as clearly seen in Fig 6. Anthocyanin pigments are visible in both inner and outer cortex cells (Fig. 6). Stele has a ring of conjoint, collateral, open

vascular bundles (Fig.5). Xylem is endarch. Interfascicular cambium forms a complete ring. Pith is large, parenchymatous and it also shows prescence of anthocynin deposition in few cells. Starch grains were visibly high in cortex and pith of plants cultivated uner water and salinity stress conditions.

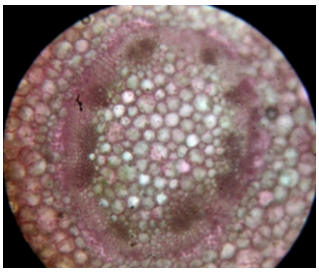

Fig. 5: V.S. Leaf showing median vascular bundle.

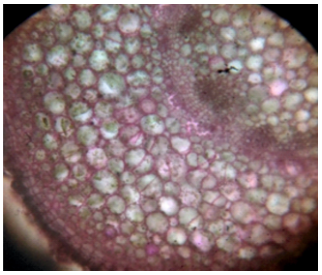

Fig. 6: Anthocyanin pigments in the chlorenchyma

The effect of salinity and water stress was clearly reflected with respect to the concentration of starch grains and anthocynin pigments. It was found that under extreme conditions of salinity stress and water stress, the concentration of idioblast, i.e., cells containing anthocyanin pigment and starch grains increases in leaf stem and petiole.

Table 1: Starch grains and anthocyanin in vegetative parts of Bryophyllum pinnatum cultivated under stress and control conditions

Sr. No.	Component	Salinity Stress		Water Stress	Control
		20ppm	10 ppm		
1.	Starch grains	+ + +	+ + +	+ +	+
2.	Anthocynin	+ + + +	+ + +	+ +	+

DISCUSSION:

According to Nelson and Sage (2007), anatomically the vegetative parts of succulents have larger cell size, high leaf succulence, reduced intercellular spaces and surface, comparatively compact mesophyll tissue. These characters are associated with the Crassulacean acid metabolism pathway.

Moreira et al. (2012) while studying the leaf anatomy of *Bryophyllum pinnatum* reported uniseriate cuticularised epidermis, having anisocytic stomata on both the abaxial as well as adaxial surfaces. They also found that the stomata were not sunken but at the same level or slightly above the level of other epidermal cells. Similar epidermal traits were found in the present studies as well. This feature of anisocytic stomata may serve as a parameter for diagnostic index of *Bryophyllum pinnatum*. It has been observed that the chlorenchymatous tissue in *Bryophyllum pinnatum* leaves is not differentiated into palisade and spongy mesophyll, but is divided into small-celled sub epidermal mesophyll and large-celled mesophyll cell. These characteristics are seen in other members of family Crassulaceae also (Duarte & Zaneti, 2002). Studies by Chernetskyy (2012) in *Kalanchoe* have shown the same.

According to Dickison (2000) and Schulze et al. (2002) leaves are highly susceptible to environmental variations, mainly light intensity. Leaves developed under high light (sun leaves) are usually smaller and thicker, frequently have a higher density of stomata, a thicker epidermis and cuticle, and more developed mesophyll compared to leaves developed under low light (shade leaves). In the present investigation while studying the effect of salinity and water stress on internal morphology, it was found that under extreme conditions of salinity stress and water stress, the concentration of idioblast, i.e., cells containing anthocyanin pigment and starchgrains increases in leaf, stem and petiole.

REFERENCES:

1. Agoha RC. Medicinal Plants of Nigeria, offset Drakkerij. Faculfcitder Wiskunde in Naturwetenschappen, The Netherlands 1974; 33:41.
2. Chopra RN, Nayar SL, Chopra IC. 1956. Glossary of Indian Medicinal Plants. Council of Scientific and Industrial Research 1956; 1:330.
3. Dickison WC 2000. Integrative Plant Anatomy. San Diego: Academic Press.
4. Elizabeth A. Nelson, and Rowan F. Sage 2007. Functional constraints of CAM leaf anatomy: tight cell packing is associated with increased CAM function across a gradient of CAM expression. Revista Brasileira de Farmacognosia
5. Jain VC, Patel Natvarlal M , Shah Dhiren P , Patel Paras Ka, Joshi Bhavesh H, 2010. Antioxidant and antimicrobial activities of Bryophyllum calycinum salisb leaf. Pharmacology 2010 (1): 393-405.
6. Jain VC, Shah DP, Patel NM 2008. Microscopical and preliminary phytochemical studies on leaves of Bryophyllum calycinum Salisb. J Pharm Res 1:230-232.
7. Moreira N S, Nascimento LBS; Marcos V LS; Tavares ES. 2012. Comparative anatomy of leaves of Kalanchoe pinnata and K. crenata in sun and shade conditions, as a support for their identification. Rev. bras. farmacogn. vol.22:5
8. Muhammad Afzal, Imran Kazmi, Ruqaiyah Khan*, Rajbala Singh, Mohit Chauhan, Tanvi Bisht, Firoz Anwar 2012. Bryophyllum pinnatum: A review
9. Schulze ED, Beck E, Müller-Hohenstein K 2002. Plant Ecology. New York: Springer.